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Molasses is Used in Pen-Feeding Arizona Livestock

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This report was prepared by the Forest Utilization Service of the Southwestern Forest and Range Experiment Station, U. S. Forest Service, for the purpose of showing the need and the industrial opportunity for a wood-molasses industry in Arizona. The information is based on a careful on-the-ground study of the resources and markets in the region and incorporates the views of technicians of the Forest Products Laboratory at Madison, Wisconsin, and qualified industrial observers.

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INDUSTRIAL MOLASSES WIDELY USED FOR LIVESTOCK FEED

Industrial molasses, principally cane (blackstrap), has long been recognized as a valuable supplement for livestock feed. Over 200 million gallons, or 1.2 million tons, are now used in the United States annually for such purposes. Approximately 40,000 tons are used annually in Arizona. The popularity of molasses as a livestock feed supplement is attributable to its high carbohydrate content. Six and one-half gallons of molasses have approximately the same carbohydrate equivalent as one bushel of corn or, in other words, molasses has 70 percent as much carbohydrate value as corn on a pound-for-pound basis. It is also valuable in the feeding of roughage or for the preservation of grass silage and in making certain feeds more palatable.

The amount of molasses used by the livestock feeding industry varies directly with the price. The price of blackstrap molasses has been characterized by wide and frequent fluctuations traceable to the nature of the product which is a byproduct of sugar manufacture. The price trend of blackstrap molasses since 1937 is shown in figure 1. These data point up the problem large molasses consumers are confronted with in providing for their long-range needs. Competition for molasses by other industries, principally industrial alcohol which presently consumes approximately one-third of the volume imported, aggravates these price fluctuations as national requirements for other products vary. Feeders in the Southwest have stated that if the price and available supply of feed molasses were stabilized increased consumption would result.

An encouraging and significant trend toward price stabilization has been the sharp expansion in recent years in the use of molasses as a feed and the decline in its use for making industrial alcohol. Production of industrial alcohol ties in closely with war and defense activities and is largely responsible for the peak price trends shown in figure 1. In recent years petroleum products have competed strongly with molasses for the production of ethyl alcohol and future markets should thus be less affected except in case of a national emergency.

1/Maintained by the Forest Service, U. S. Department of Agriculture, for Arizona, New Mexico, and west Texas, with headquarters in Tucson, Arizona.

Monthly price per ton f.o.b. port of entry for blackstrap molasses

Figure 1

RESEARCH SHOWS PRODUCTION OF INDUSTRIAL MOLASSES FROM WOOD WASTE POSSIBLE

While a few problems, principally improved storage life, remain to be solved, tests show that good feed molasses can be made from wood waste. Wood, as it occurs in the raw form, contains about 65 to 76 percent carbohydrated material in the form of cellulose and hemicellulose. These materials are indigestible as they occur in the wood and must be converted to a digestible form (wood sugar) before they can be used. This conversion is accomplished by means of a process known as hydrolysis.

By the hydrolysis method, wood in the form of chips or sawdust is treated with dilute sulfuric acid (0.4% to 0.6% concentration) under steadily increasing steam pressure (the Madison process) until the carbohydrate portions are largely converted to sugars. The sugars are removed and neutralized with lime.

The neutral sugar solution is then evaporated to a molasses containing approximately 50 percent sugar by concentrating tenfold. At a 50-percent concentration, it is possible to produce approximately a ton of molasses from a ton of wood waste on a dry, bark-free basis.

If ammonia is used for neutralization instead of lime, problems of scaling evaporator tubes during subsequent concentration are eliminated. Added feed value arises from the ammonium sulfate formed.

Wood molasses has a bitter-sweet taste to humans similar to that of blackstrap. It is palatable to cattle, sheep, hogs, and poultry.

Feeding tests conducted by a number of state agricultural experiment stations have established the feed value of wood molasses as equivalent to cane molasses. Tests included dairy and beef cattle, sheep, hogs, and poultry. These were designed and controlled to compare the palatability and nutritional value of wood molasses to that of cane molasses and also to determine if wood molasses flavored the milk, meat, or eggs. The concensus of the various institutions conducting the tests was that wood molasses was equal to cane molasses as a livestock feed supplement.[2/] There was no evidence to show that it affected the flavor of milk, meat, or eggs.

FACTORS TO CONSIDER IN WOOD-MOLASSES PRODUCTION

Assuming the storage life of wood molasses can be improved, major factors in profitable production are: a sufficient supply of suitable raw material, adequate transportation facilities, ample markets, and low production costs.

Results of a study of these factors as they apply to the production of wood molasses in Arizona show the following:

The Supply of Suitable Raw Material Ample and Available

Information developed to date on the production of wood molasses has shown that virtually any type of wood waste is suitable. Sawdust, slabs, shavings, and cull trees have been successfully tested. Bark and decayed wood may be used but the yields are low because of low cellulose content. Tests[3/] made on ponderosa pine mill waste produced in Arizona gave satisfactory results. The cost of collection and transportation largely governs the selection of waste and places considerable advantage in mill waste.

2/Harris, E. E., & Lloyd, R. A. Wood molasses from ponderosa pine. Report on tests. On file at SW For. & Range Expt. Sta., Tucson, Ariz. 1951.

3/Harris, E. E. Hydrolysis of wood for stock feed. For. Prod. Lab., Madison, Wis.

On the basis of pilot-plant studies it has been estimated that the smallest practical molasses plant based on present methods should process 50 tons of wood waste per day on a dry-weight basis. In the production of 1,000 board feet of lumber about 1 ton of wood waste, dry basis, is produced. To supply the raw-material requirements of a 50-ton-capacity molasses plant in the form of mill waste, a daily cut of about 60,000 board feet of lumber would be required, including the necessary allowance for bark and other low-yielding material. Expressed in terms of yearly capacity, a 50-ton molasses plant would require approximately 18,000 tons of mill waste on a bark-free, dry basis or the equivalent of the amount of waste resulting from the production of approximately 22 million board feet of lumber.

A study of the lumber-manufacturing industry in Arizona shows that there are a number of areas where the raw-material requirements for a 50-ton molasses plant could be met on a permanent basis. These are as follows:

	Daily waste (Tons)
Flagstaff	180
McNary, Southwest Lumber Mills, Inc.	50-60
Winslow	90

Because of the expense involved in transporting mill waste, there is a strong economic advantage in locating a molasses plant where the raw-material requirements can be met from a single source and preferably moved by means of conveyor directly from the mill to the molasses plant. A number of mills offer such an advantage.

Two mills at Flagstaff are presently converting most of their mill waste to electric power. Natural gas is available to the mills and it would therefore be possible for them to use it as a source of fuel provided the return from the wood waste would equal or exceed the cost of the natural gas. Preliminary discussion with the management of these mills reflects favorably on such a conversion.

The volume of mill waste shown for the mill at McNary is now uncommitted and the management of the firm has indicated that the material would be available for wood-molasses development.

Except for a small volume of edgings that are selected for molding, the mill waste developed in the Winslow area is uncommitted and would be available.

Transportation Facilities are Adequate

Transportation of finished products is a major production-cost item and establishes certain limits to any proposed operation. The cost of distribution of wood molasses from the plant to the consumption area regulates the area in which wood molasses remains competitive.

It is estimated that bulk hauling of wood molasses by common carrier can be done for an average of about 6 cents per ton-mile. The following table shows the distances from Flagstaff to various principal livestock-feeding centers in Arizona and neighboring states and the present published tariffs by common carrier to these points:

	Miles	NOI class 4 rate per ton
From Flagstaff to Phoenix, Arizona	216	$17.20
" Clovis, New Mexico	547	30.60
" El Paso, Texas	543	24.80
" Tucson, Arizona	340	22.00
" Salt Lake City, Utah	516	52.80
" Pueblo, Colorado	628	32.20
" Omaha, Nebraska	1,209	41.80
" Yuma, Arizona	410	24.00

Present rates do not include wood molasses other than as a "not otherwise indexed" item and are therefore not indicative of what negotiated tariffs might be. NOI items carry a minimum class 4 rate which is considerably higher than either the class 5 or commodity rates. The most favorable hauling would be under commodity rates which would require actual negotiations between producer and carrier with I.C.C. or State Corporate Commission acceptance.

A sample of a negotiated commodity rate that might be arranged is the $10-per-ton rate from Flagstaff to Phoenix mentioned by both railroad and motor-freight officials. Such a rate, if applied proportionately to other shipping points, would greatly extend the competitive zone for wood molasses.

Prospective operators might wish to consider self-owned or leased trucks in preference to common-carrier hauling. Tank-truck and trailer units capable of hauling a pay load of 30 tons can be purchased for from $20,000 to $25,000 fully equipped. Two such units could adequately handle the production of a 50-ton plant. It is estimated that this class vehicle could be operated at from $0.45 to $0.55 per mile, or at one-half capacity

(considering an empty back haul) for from $0.03 to $0.035 per ton-mile. This cost includes depreciation, driver's wages, insurance, taxes, maintenance, and fuel.

The estimated hauling costs by privately owned trucks to various market areas in and outside the State are shown in the following table:

	Miles	Cost per ton at $0.0325 per mi.
From Flagstaff to Phoenix, Arizona	216	$ 7.02
" Clovis, New Mexico	547	17.78
" El Paso, Texas	543	17.65
" Tucson, Arizona	340	11.05
" Salt Lake City, Utah	516	16.77
" Pueblo, Colorado	628	20.41
" Omaha, Nebraska	1,209	39.29
" Yuma, Arizona	410	13.32

Leased trucks can be legally operated provided the commodity does not enter into interstate commerce or as long as payments are not made on an individual trip ton-mile basis. There are no estimates available as to the lease facilities.

Ample Markets Exist

Markets for wood molasses lie principally in livestock and other farm-animal feeds. Probably 90 percent of the total molasses presently consumed in the Southwest is in pen-feeding operations. The great bulk of the cattle that are annually slaughtered within the area or shipped out to other slaughtering areas are fed a final fattening ration for from 30 to 120 days. Most rations contain molasses in amounts from 5 to 15 percent dry weight. Additional quantities of molasses are used by commercial feed mills which produce various types of prepared feeds for farm use. Some limited amounts of molasses have been bulk fed or sprayed on low-palatable pasture crops. A limited amount is used annually for the preparation of silage.

It is possible that markets for blackstrap and other industrial molasses could be captured by a local wood-molasses industry. As pointed out previously, molasses prices have been highly variable in past years and the molasses market often has been in a distressed condition (fig. 1). In addition to the causes mentioned, much of the price instability of cane molasses is attributable to changes in world markets. A change in European economy, for example, last year had a very pronounced effect on the molasses supply. A local production designed to

meet a local market probably would be much less affected by international or even national market upheavals, and the price should be correspondingly much more stable.

The principal pen-feeding centers and the estimated animals fed in 1951 are as follows:

Location	Animals fed in 1951
Salt River Valley-Casa Grande	300,000
Yuma-El Centro area	650,000
Tucson-Nogales area	10,000
Utah	40,000
New Mexico	90,000
Colorado	1,515,000
West Texas	275,000
Total	2,880,000

The daily per-animal consumption of molasses will vary with the composition of the supplemental feed. On the average, about 2 or 3 pounds of molasses per day will be consumed by cattle. Although the period of supplemental feed will vary from as little as 30 days to over 120, it is estimated that the average feeding period will approximate 60 days. With a total of some three million animals being pen fed an average of 2 pounds of molasses for a period of 60 days, the total possible consumption of molasses for the area would approximate 360 million pounds or 180 thousand tons per year. Considering pen-feeding consumption to be 90 percent of the total, it is possible that some 200 thousand tons would be the potential market in the Southwest. A more favorable price probably would increase this use by as much as 25 percent, based on the general trend towards increased supplemental feed and the growing acceptance of the molasses component.

As shown in the above tabulation, the Phoenix area alone, with its daily molasses requirement of 50 tons, would meet the market needs of a 50-ton plant. The additional demand from other adjacent marketing areas enhances the possibilities for wood-molasses production.

Favorable Production Costs Possible

Since no commercial plant has yet been constructed in the United States there is a limited foundation of information on which to base cost estimates. Hence, estimates must be interpreted liberally. However, estimates that follow are considered conservative and indicate that wood molasses could be produced and marketed in Arizona at a total delivered price competitive with cane molasses even during moderately depressed cane-price cycles. The long-term average selling cost of wood molasses should be significantly lower. Additional values would be realized in providing a steady supply of a uniform product.

Production costs[4] for 50 percent wood-sugar molasses, based on a capacity of 50 tons of dry-wood substance per day (2,041,666 gal. of molasses per yr., 325 operating days) are as follows:

Direct production costs	Cost per gal. (Cents)
A. Raw materials	3.21
B. Utilities	5.96
C. Operating labor[1]	2.45
D. Supervision (10% of operating labor)	0.25
E. Payroll overhead (20% of labor and supervision)	0.54
F. Maintenance (5% of plant cost)	1.51
G. Supplies (15% of maintenance)	0.23
Indirect production costs	
Technical and analytical services, transportation, medical services, etc. (60% of labor, maintenance, and supervision)	2.54
Fixed costs	
A. Depreciation (10% of investment)	3.07
B. Local taxes (1% of investment)	0.31
C. Insurance (1% of investment)	0.31
Total production cost per gallon	20.4
or $34.68 per ton	

1/Based on an operating labor force of three men per shift and two additional men during day shift when chips for 24-hour operation would be prepared.

Under present depressed market conditions the production cost figure of $35 per ton or 20¢ per gallon as estimated for locally produced molasses is above the f.o.b. price for imported stock at port terminals. With this price-cost relation in the immediate offing the opportunity for interesting the necessary capital in a local wood-molasses development would not appear encouraging. However, when the overall price pattern of blackstrap molasses and the factors that influence it are carefully analyzed and weighed against current trends, and the advantages of a local source of supply are fully taken into account, the

4/Gilbert, Nathan, Hobbs, I. A., & Lavine, J. D. Hydrolysis of wood using dilute sulfuric acid. Industrial & Engineering Chemistry, Vol. 44, No. 7, pp. 1712-1720. July 1952. (Tennessee Valley Authority, Wilson Dam, Ala.)

picture takes on a considerably brighter appearance. The fact that molasses, on an equivalent feeding basis, was a more economical feed than corn from the period 1945 through 1950 cannot be lightly overlooked and leads to the conclusion that many feeders plan to continue its use.

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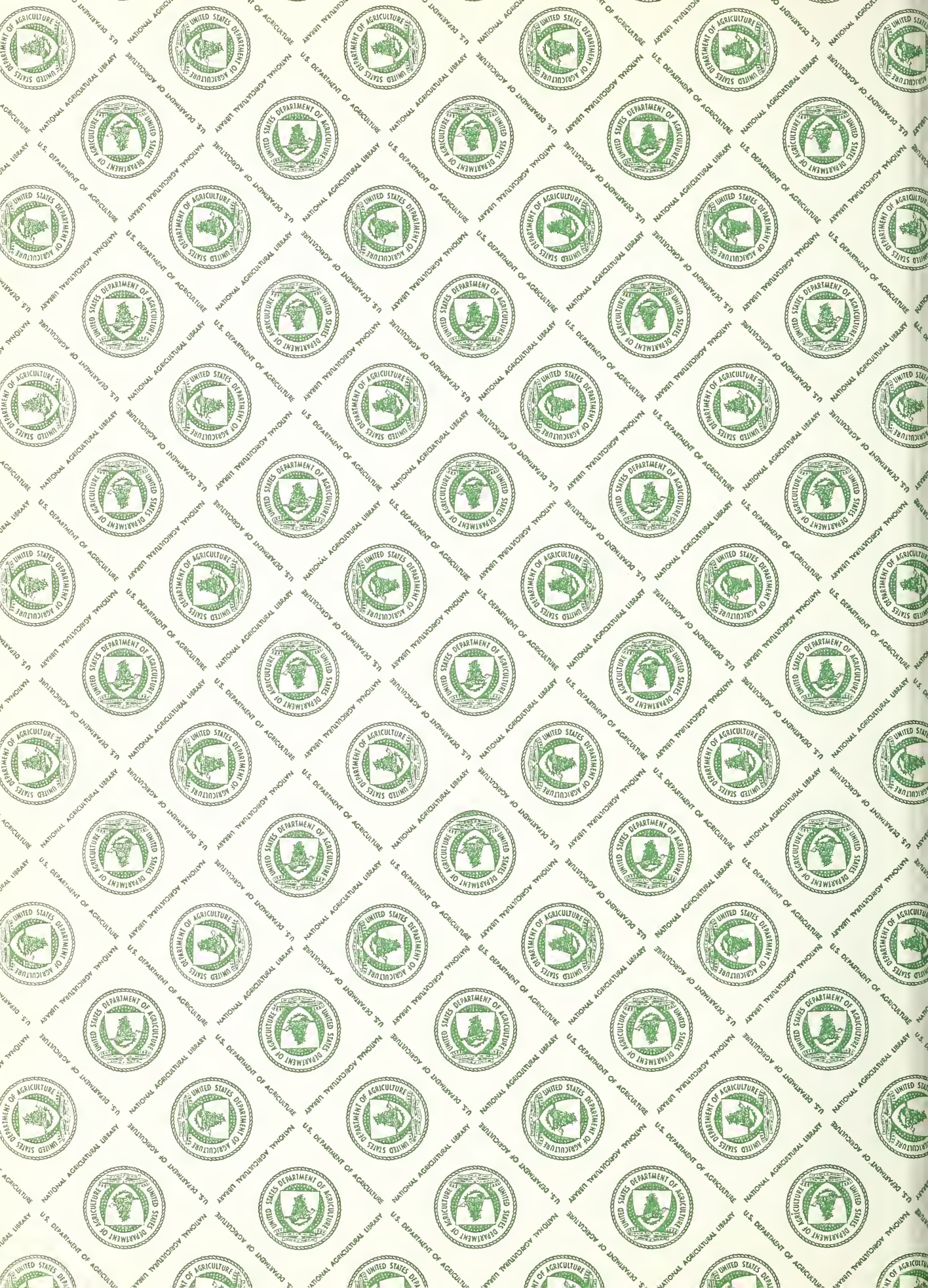
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